

1 What is claimed is:

2

3 ~~1~~ A sound source apparatus having operation blocks composed of
4 softwares used to compute waveforms for generating a plurality of musical
5 tones through a plurality of channels according to performance information, the
6 apparatus comprising:

7 a setting device for setting an algorithm which determines a system
8 composed of selective ones of the operation blocks systematically combined
9 with each other to compute a waveform specific to one of the musical tones;

10 a designating device responsive to the performance information for
11 designating one of the channels to be used for generating said one musical tone;
12 and

13 a generating device for allocating the selective operation blocks to said
14 one channel and for systematically executing the allocated selective operation
15 blocks according to the algorithm so as to compute the waveform to thereby
16 generate said one musical tone through said one channel.

17

18 2 A sound source apparatus according to claim 1, wherein the setting
19 device sets different algorithms which determine different systems
20 corresponding to different timbres of the musical tones, each of the different
21 systems being composed of selective ones of the operation blocks which are
22 selectively and sequentially combined with each other to compute a waveform
23 which is specific to a corresponding one of the different timbres.

24

25 3 A sound source apparatus according to claim 2, wherein the setting
26 device comprises a determining device that determines a first system

1 combining a great number of operation blocks and corresponding to a regular
2 timbre and that determines a second system combining a small number of
3 operation blocks and corresponding to a substitute timbre, and a changing
4 device operative when a number of operation blocks executable in the channel
5 is limited under said great number and over said small number due to a load of
6 the computation of the waveform for changing the musical tone from the
7 regular timbre to the substitute timbre so that the second system is adopted for
8 the channel in place of the first system.

9

10 4 A sound source apparatus according to claim 1, wherein the setting
11 device comprises an adjusting device operative dependently on a condition
12 during the course of generating the musical tone for adjusting a number of the
13 operation blocks to be allocated to the channel.

14

~~Substantive~~ 5 A sound source apparatus according to claim 4, wherein the adjusting
16 device comprises a modifying device that modifies the algorithm to eliminate a
17 predetermined one of the operation blocks involved in the system so as to
18 reduce a number of the operation blocks to be loaded into the channel for
19 adjustment to the condition.

20

21 6 A sound source apparatus according to claim 4, wherein the adjusting
22 device operates when the condition indicates that an amplitude envelope of the
23 waveform attenuates below a predetermined threshold level for compacting the
24 system so as to reduce the number of the operation blocks.

25

1 7 A sound source apparatus according to claim 4, wherein the adjusting
2 device operates when the condition indicates that an output volume of the
3 musical tone is tuned below a predetermined threshold level for compacting the
4 system so as to reduce the number of the operation blocks.

5

Subj 627 8 A sound source apparatus according to claim 4, wherein the adjusting
7 device operates when the condition indicates that one of the operation blocks
8 declines to become inactive in the system without substantially affecting other
9 operation blocks of the system for eliminating said one operation block so as to
10 reduce the number of the operation blocks to be allocated to the channel.

11

12 9 A sound source apparatus according to claim 1, wherein the generating
13 device comprises a computing device responsive to a variable sampling
14 frequency for executing the operation blocks to successively compute samples
15 of the waveform in synchronization to the variable sampling frequency so as to
16 generate the musical tone, and a controlling device that sets the variable
17 sampling frequency according to process of computation of the waveform by
18 the operation blocks.

19

20 10 A sound source apparatus according to claim 1, wherein the generating
21 device comprises a computing device responsive to a variable sampling
22 frequency for executing the operation blocks to successively compute samples
23 of the waveform in synchronization to the variable sampling frequency so as to
24 generate the musical tone, and a controlling device for adjusting the variable
25 sampling frequency dependently on a load of computation of the waveform
26 during the course of generating the musical tone.

1

2 11 A sound source apparatus according to claim 1, wherein the generating
3 device comprises a computing device responsive to a variable sampling
4 frequency for executing the operation blocks to successively compute samples
5 of the waveform in synchronization to the variable sampling frequency so as to
6 generate the musical tone, and a controlling device for adjusting the variable
7 sampling frequency according to result of computation of the samples during
8 the course of generating the musical tone.

9

~~12~~ /13.

10 ~~12~~ A sound source apparatus having a software module used to compute
11 samples of a waveform in response to a sampling frequency for generating a
12 musical tone according to performance information, the apparatus comprising:
13 a processor device that periodically executes the software module for
14 successively computing samples of the waveform corresponding to a variable
15 sampling frequency so as to generate the musical tone;
16 a detector device for detecting a load of computation imposed on the
17 processor device during the course of generating the musical tone; and
18 a controller device operative according to the detected load for changing
19 the variable sampling frequency to adjust a rate of computation of the samples.

20 /14.

/3

21 ~~13~~ A sound source apparatus according to claim ~~12~~, wherein the controller
22 device provides a fast sampling frequency when the detected load is relatively
23 light, and provides a slow sampling frequency when the detected load is
24 relatively heavy such that the rate of the computation of the samples is reduced
25 by $1/n$ where n denotes an integer number.

26

15.

1 14 A sound source apparatus according to claim 13, wherein the processor
2 device includes a delay device having a memory for imparting a delay to the
3 waveform to determine a pitch of the musical tone according to the
4 performance information, the delay device generating a write pointer for
5 successively writing the samples into addresses of the memory and a read
6 pointer for successively reading the samples from ^{addresses}₁ of the memory to
7 thereby create the delay corresponding to an address gap between the write
8 pointer and the read pointer, the delay device being responsive to the fast
9 sampling frequency to increment both of the write pointer and the read pointer
10 by one address for one sample, otherwise the delay device being responsive to
11 the slow sampling frequency to increment the write pointer by one address n
12 times for one sample and to increment the read pointer by n addresses for one
13 sample.

14 16.

14

15 15 A sound source apparatus according to claim 13, wherein the processor
16 device includes a delay device having a pair of memory regions for imparting a
17 delay to the waveform to determine a pitch of the musical tone according to the
18 performance information, the delay device successively writing the samples of
19 the waveform of one ^{musical}₁ tone into addresses of one of the memory regions
20 and successively reading the samples from addresses of the same memory
21 region to thereby create the delay, the delay device being operative when said
22 one musical tone is switched to another musical tone for successively writing
23 the samples of the waveform of said another ^{musical}₁ tone into addresses of the
24 other memory region and successively reading the samples from addresses of
25 the same memory region to thereby create the delay while clearing the one
26 memory region to prepare for a further musical tone.

1 17. **16** A sound source apparatus according to claim 12, wherein the processor
2 device executes the software module composed of a plurality sub-modules for
3 successively computing the waveform, the processor device being operative
4 when one of the sub-modules declines to become inactive without substantially
5 affecting other sub-modules during computation of the waveform for skipping
6 execution of said one sub-module.

20.

9 17 A sound source apparatus having a software module used to compute
10 samples of a waveform for generating a musical tone, the apparatus
11 comprising:

12 a provider device for variably providing a trigger signal at a relatively
13 slow rate to define a frame period between successive trigger signals, and for
14 periodically providing a sampling signal at a relatively fast rate such that a
15 plurality of sampling signals occur within one frame period;

16 a processor device resettable in response to each trigger signal and
17 operable to periodically execute the software module for successively
18 computing a number of samples of the waveform corresponding to the
19 sampling signals within one frame;

20 a detector device for detecting a load of computation imposed on the
21 processor device during the course of generating the musical tone;

22 a controller device operative according to the detected load for varying
23 the frame period to adjust the number of the samples computed within one
24 frame period, and

1 a converter device responsive to each sampling signal for converting
2 each of the samples into a corresponding analog signal to thereby generate the
3 musical tones.

4 21.

5 ~~18~~ A sound source apparatus having submodules composed of softwares
6 used to compute waveforms for generating a plurality of musical tones through
7 a plurality of channels according to performance information, the apparatus
8 comprising:

9 setting means for setting an algorithm which determines a module
10 composed of selective ones of the submodules logically connected to each
11 other to compute a waveform specific to one of the musical tones;

12 designating means responsive to the performance information for
13 designating one of the channels to be used for generating said one musical tone;
14 and

15 generating means for loading the selective submodules into said one
16 channel and for logically executing the allocated selective submodules
17 according to the algorithm so as to compute the waveform to thereby generate
18 said one musical tone through said one channel.

19 22.

21

20 ~~19~~ A sound source apparatus according to claim ~~18~~, wherein the setting
21 means sets different algorithms which determine different modules
22 corresponding to different timbres of the musical tones, each of the different
23 modules being composed of selective ones of the submodules which are
24 selectively and sequentially connected to each other to compute a waveform
25 which is specific to a corresponding one of the different timbres.

26

23.

1 *26* A sound source apparatus according to claim *18*, wherein the setting
2 means comprises adjusting means operative dependently on a condition during
3 the course of generating the musical tone for adjusting a number of the
4 submodules to be loaded into the channel.

5 *24.*

6 *21* A sound source apparatus according to claim *18*, wherein the adjusting
7 means operates when the condition indicates that an amplitude envelope of the
8 waveform attenuates below a predetermined threshold level for compacting the
9 module so as to reduce the number of the submodules.

10 *25.*

11 *22* A sound source apparatus according to claim *18*, wherein the adjusting
12 means operates when the condition indicates that an output volume of the
13 musical tone is tuned below a predetermined threshold level for compacting the
14 module so as to reduce the number of the submodules.

15 *26.*

16 *23* A sound source apparatus according to claim *18*, wherein the adjusting
17 means operates when the condition indicates that one of the submodules loses
18 contribution to computation of the waveform without substantially affecting
19 other submodules for eliminating said one submodule so as to reduce the
20 number of the submodules to be loaded into the channel.

21 *27.*

22 *24* A sound source apparatus having a software module used to compute
23 samples of a waveform in response to a sampling frequency for generating a
24 musical tone according to performance information, the apparatus comprising:

1 processor means to periodically execute the software module for
2 successively computing samples of the waveform corresponding to a variable
3 sampling frequency so as to generate the musical tone;

4 detector means for detecting a load of computation imposed on the
5 processor means during the course of generating the musical tone; and

6 controller means operative according to the detected load for changing
7 the variable sampling frequency to adjust a rate of computation of the samples.

8 28.

27

9 25 A sound source apparatus according to claim 24, wherein the controller
10 means provides a fast sampling frequency when the detected load is relatively
11 light, and provides a slow sampling frequency when the detected load is
12 relatively heavy such that the rate of the computation of the samples is reduced
13 by $1/n$ where n denotes an integer number.

14 30.

28

15 26 A sound source apparatus according to claim 25, wherein the processor
16 means includes delay means having a memory for imparting a delay to the
17 waveform to determine a pitch of the musical tone according to the
18 performance information, the delay means generating a write pointer for
19 successively writing the samples into addresses of the memory and a read
20 pointer for successively reading the samples from ~~addresses~~ of the memory to
21 thereby create the delay corresponding to an address interval between the write
22 pointer and the read pointer, the delay means being responsive to the fast
23 sampling frequency to increment both of the write pointer and the read pointer
24 by every one address for every one sample, otherwise the delay means being
25 responsive to the slow sampling frequency to increment the write pointer by
26 every one address at n times for repeatedly writing one sample into consecutive

1 n addresses and to skip the read pointer by consecutive n addresses for reading
2 one sample.

3 31.

4 ~~21~~ A sound source apparatus having a software module used to compute
5 samples of a waveform for generating a musical tone, the apparatus
6 comprising:

7 provider means for variably providing a trigger signal at a relatively slow
8 rate to define a frame period between successive trigger signals, and for
9 periodically providing a sampling signal at a relatively fast rate such that a
10 plurality of sampling signals occur within one frame period;

11 processor means resettable in response to each trigger signal and
12 operable based on each sampling signal to periodically execute the software
13 module for successively computing a number of samples of the waveform
14 within one frame period;

15 detector means for detecting a load of computation imposed on the
16 processor means during the course of generating the musical tone;

17 controller means operative according to the detected load for varying the
18 frame period to adjust the number of the samples computed within one frame
19 period, and

20 converter means responsive to each sampling signal for converting each
21 of the samples into a corresponding analog signal to thereby generate the
22 musical tones.

23 32.

24 ~~28~~ A sound source apparatus having a software module used to compute
25 samples of a waveform for generating a musical tone, the apparatus
26 comprising:

1 provider means for periodically providing a trigger signal at a relatively
2 slow rate to define a frame period between successive trigger signals, and for
3 periodically providing a sampling signal at a relatively fast rate such that a
4 plurality of sampling signals occur within one frame period;

5 processor means resettable in response to a trigger signal and operable in
6 response to each sampling signal to periodically execute the software module
7 for successively computing a number of samples of the waveform within one
8 frame period; and

9 converter means responsive to each sampling signal for converting each
10 of the samples into a corresponding analog signal to thereby generate the
11 musical tones, wherein

12 the processor means includes delay means having a pair of memory
13 regions for imparting a delay to the waveform to determine a pitch of the
14 musical tone according to the performance information, the delay means
15 successively writing the samples of the waveform of one ^{musical} tone into
16 addresses of one of the memory regions and successively reading the samples
17 from ^{addresses} of the same memory region to thereby create the delay, the delay
18 means being operative when the processor means is reset so that said one
19 musical tone is switched to another musical tone for successively writing the
20 samples of the waveform of said another ^{musical} tone into addresses of the
21 other memory region and successively reading the samples from ^{addresses} of the
22 same memory region to thereby create the delay while clearing the one memory
23 region to prepare for a further musical tone.

24 33.

25 29 A method using submodules composed of softwares to compute
26 waveforms for generating a plurality of musical tones through a plurality of

1 channels according to performance information, the method comprising the
2 steps of:

3 setting an algorithm which determines a module composed of selective
4 ones of the submodules logically connected to each other to compute a
5 waveform specific to one of the musical tones;

6 designating one of the channels to be used for generating said one
7 musical tone in response to the performance information;

8 loading the selective submodules into said one channel; and

9 logically executing the loaded selective submodules according to the
10 algorithm so as to compute the waveform to thereby generate said one musical
11 tone through said one channel.

12 *34.*

33

13 *30* A method according to claim *29*, wherein the step of setting sets different
14 algorithms which determine different modules corresponding to different
15 timbres of the musical tones, each of the different modules being composed of
16 selective ones of the submodules which are selectively and sequentially
17 connected to each other to compute a waveform which is specific to a
18 corresponding one of the different timbres.

19 *35.*

33

20 *31* A method according to claim *29*, wherein the step of setting comprises
21 adjusting a number of the submodules to be loaded into the channel
22 dependently on a condition during the course of generating the musical tone.

23 *36.*

35

24 *32* A method according to claim *31*, wherein the step of adjusting comprises
25 compacting the module so as to reduce the number of the submodules when the

1 condition indicates that an amplitude envelope of the waveform attenuates
2 below a predetermined threshold level.

3 ~~37.~~ ³⁵
4 ~~38~~ A method according to claim ~~31~~, wherein the step of adjusting comprises
5 compacting the module so as to reduce the number of the submodules when the
6 condition indicates that an output volume of the musical tone is tuned below a
7 predetermined threshold level.

8

~~Subj 34~~ A method according to claim 31, wherein the step of adjusting comprises
10 eliminating one submodule so as to reduce the number of the submodules to be
11 loaded into the channel when the condition indicates that said one submodule
12 loses contribution to computation of the waveform without substantially
13 affecting other submodules.

14 ~~39.~~ ^{35.}
15 A method using a hardware processor and a software module to compute
16 samples of a waveform in response to a sampling frequency for generating a
17 musical tone according to performance information, the method comprising the
18 steps of:

19 periodically operating the hardware processor to execute the software
20 module for successively computing samples of the waveform corresponding to
21 a variable sampling frequency so as to generate the musical tone;

22 detecting a load of computation imposed on the hardware processor
23 during the course of generating the musical tone; and

24 changing the variable sampling frequency according to the detected load
25 to adjust a rate of computation of the samples.

26

40.

39

1 36 A method according to claim 35, wherein the step of changing provides a
2 fast sampling frequency when the detected load is relatively light, and provides
3 a slow sampling frequency when the detected load is relatively heavy.

4 41

5 37 A method using a hardware processor having a software module used to
6 compute samples of a waveform for generating a musical tone, the method
7 comprising the steps of:

8 variably providing a trigger signal at a relatively slow rate to define a
9 frame period between successive trigger signals;

10 periodically providing a sampling signal at a relatively fast rate such that
11 a plurality of sampling signals occur within one frame period;

12 operating the hardware processor resettable in response to each trigger
13 signal and operable based on each sampling signal to periodically execute the
14 software module for successively computing a number of samples of the
15 waveform within one frame period;

16 detecting a load of computation imposed on the software processor
17 during the course of generating the musical tone;

18 varying the frame period according to the detected load to adjust the
19 number of the samples computed within one frame period, and

20 converting each of the samples into a corresponding analog signal in
21 response to each sampling signal to thereby generate the musical tones.

22 42

23 38 A method using a hardware processor having a software module used to
24 compute samples of a waveform for generating a musical tone, the method
25 comprising the steps of:

1 periodically providing a trigger signal at a relatively slow rate to define a
2 frame period between successive trigger signals;

3 periodically providing a sampling signal at a relatively fast rate such that
4 a plurality of sampling signals occur within one frame period;

5 operating the hardware processor resettable in response to a trigger
6 signal and operable based on each sampling signal to periodically execute the
7 software module for successively computing a number of samples of the
8 waveform within one frame period; and

9 converting each of the samples into a corresponding analog signal in
10 response to each sampling signal to thereby generate the musical tones,
11 wherein

12 the step of operating includes delay step using a pair of memory regions
13 for imparting a delay to the waveform to determine a pitch of the musical tone
14 according to the performance information, the delay step successively writing
15 the samples of the waveform of one *musical* tone into addresses of one of the
16 memory regions and successively ¹reading the samples from *addresses* of the
17 same memory region to thereby create the delay, the delay step responding
18 when the hardware processor is reset so that said one musical tone is switched
19 to another musical tone for successively writing the samples of the waveform
20 of said another *musical* tone into addresses of the other memory region and
21 successively reading the samples from *addresses* of the same memory region to
22 thereby create the delay while clearing the one memory region to prepare for a
23 further musical tone.

24 43
25 39 A machine readable media for use in a prprocessor machine including a
26 CPU, said media containing program instructions executable by said CPU for

1 causing the processor machine having submodules composed of softwares to
2 compute waveforms for performing operation of generating a plurality of
3 musical tones through a plurality of channels according to performance
4 information, wherein the operation comprises the steps of:

5 setting an algorithm which determines a module composed of selective
6 ones of the submodules logically connected to each other to compute a
7 waveform specific to one of the musical tones;

8 designating one of the channels to be used for generating said one
9 musical tone in response to the performance information;

10 loading the selective submodules into said one channel; and

11 logically executing the loaded selective submodules according to the
12 algorithm so as to compute the waveform to thereby generate said one musical
13 tone through said one channel.

14 44.

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15 40 A machine readable media according to claim 39, wherein the step of
16 setting sets different algorithms which determine different modules
17 corresponding to different timbres of the musical tones, each of the different
18 modules being composed of selective ones of the submodules which are
19 selectively and sequentially connected to each other to compute a waveform
20 which is specific to a corresponding one of the different timbres.

21 45.

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22 41 A machine readable media according to claim 39, wherein the step of
23 setting comprises adjusting a number of the submodules to be loaded into the
24 channel dependently on a condition during the course of generating the musical
25 tone.

26

46.

1 42 A machine readable media according to claim 41, wherein the step of
2 adjusting comprises compacting the module so as to reduce the number of the
3 submodules when the condition indicates that an amplitude envelope of the
4 waveform attenuates below a predetermined threshold level.

5 47.

6 43 A machine readable media according to claim 41, wherein the step of
7 adjusting comprises compacting the module so as to reduce the number of the
8 submodules when the condition indicates that an output volume of the musical
9 tone is tuned below a predetermined threshold level.

10

Sura 11 44 A machine readable media according to claim 41, wherein the step of
12 adjusting comprises eliminating one submodule so as to reduce the number of
13 the submodules to be loaded into the channel when the condition indicates that
14 said one submodule loses contribution to computation of the waveform without
15 substantially affecting other submodules.

16 49.

17 45 A machine readable media for use in a processor machine including a
18 CPU, said media containing program instructions executable by said CPU for
19 causing the processor machine having a software module to compute samples
20 of a waveform in response to a sampling frequency for performing operation of
21 generating a musical tone according to performance information, wherein the
22 operation comprises the steps of:

23 periodically operating the processor machine to execute the software
24 module for successively computing samples of the waveform corresponding to
25 a variable sampling frequency so as to generate the musical tone;

1 detecting a load of computation imposed on the processor machine
2 during the course of generating the musical tone; and
3 changing the variable sampling frequency according to the detected load
4 to adjust a rate of computation of the samples.

10 51.
11 A machine readable media for use in a processor machine including a
12 CPU, said media containing program instructions executable by said CPU for
13 causing the processor machine having a software module used to compute
14 samples of a waveform for performing operation of generating a musical tone,
15 wherein the operation comprises the steps of:

16 variably providing a trigger signal at a relatively slow rate to define a
17 frame period between successive trigger signals;

periodically providing a sampling signal at a relatively fast rate such that
a plurality of sampling signals occur within one frame period;

20 operating the processor machine resettable in response to each trigger
21 signal and operable based on each sampling signal to periodically execute the
22 software module for successively computing a number of samples of the
23 waveform within one frame period;

24 detecting a load of computation imposed on the processor machine
25 during the course of generating the musical tone;

1 varying the frame period according to the detected load to adjust the
2 number of the samples computed within one frame period, and
3 converting each of the samples into a corresponding analog signal in
4 response to each sampling signal to thereby generate the musical tones.

5 52.
6 48 A machine readable media for use in a processor machine including a
7 CPU, said media containing program instructions executable by said CPU for
8 causing the processor machine having a software module used to compute
9 samples of a waveform for performing operation of generating a musical tone,
10 wherein the operation comprises the steps of:

11 periodically providing a trigger signal at a relatively slow rate to define a
12 frame period between successive trigger signals;

13 periodically providing a sampling signal at a relatively fast rate such that
14 a plurality of sampling signals occur within one frame period;

15 operating the processor machine resettable in response to a trigger signal
16 and operable based on each sampling signal to periodically execute the
17 software module for successively computing a number of samples of the
18 waveform within one frame; and

19 converting each of the samples into a corresponding analog signal in
20 response to each sampling signal to thereby generate the musical tones,
21 wherein

22 the step of operating includes delaying step using a pair of memory
23 regions for imparting a delay to the waveform to determine a pitch of the
24 musical tone according to the performance information, the delay step
25 successively writing the samples of the waveform of one musical tone into
26 addresses of one of the memory regions and successively reading the samples

a 1 from addresses of the same memory region to thereby create the delay, the delay
2 step responding when the processor machine is reset so that said one musical
3 tone is switched to another musical tone for successively writing the samples of
4 the waveform of said another musical tone into addresses of the other memory
5 region and successively reading the samples from addresses of the same memory
6 region to thereby create the delay while clearing the one memory region to
7 prepare for a further musical tone.

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